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NOTES ON THE TAXONOMY AND BIOLOGY OF SPECIES OF *PARASARCOPHAGA* JOHNSTON & TIEGS AND *BARANOVISCA* LOPES (DIPTERA: SARCOPHAGIDAE) ASSOCIATED WITH SPIDERS IN EASTERN AUSTRALIA

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Abstract

Parasarcophaga cyrtophorae sp. n. is described and distinguished from the closely related species *Baranovisca arachnivora* Lopes and *B. reposita* (Lopes); the genus *Baranovisca* Lopes is discussed. Observations on the association between *P. cyrtophorae*, *B. reposita* and the spider *Cyrtophora moluccensis* (Doleschall) in Brisbane, Queensland are presented.

Introduction

Baranovisca reposita (Lopes) was originally described in *Parasarcophaga* Johnston & Tiegs from a single male from Sydney, New South Wales "feeding in a spiders cocoon", an unusual habit for a species of Sarcophagidae. The identification by Cantrell (1981) of a series of sarcophagid flied reared from the egg cases of the spider *Cyrtophora moluccensis* (Doleschall) (Araneidae) as *P. reposita* Lopes was thus based partly on conjecture because of host similarity. However comparison of specimens with Lopes' description and illustrations showed close resemblance. The incomplete holotype of *P. reposita* (the terminalia preparation was not available at that time) was then examined and found to be apparently identical to available specimens. With the identification seemingly correct, *P. reposita* was redescribed, including information on the female and the immature stages.

The redescription was made from specimens collected in Papua New Guinea and Brisbane, Australia during 1980. Observations of spiders continued in Brisbane in 1981-1985 and many more flies were recovered. The species is easily recognized by its distinctive puparium (Fig. 20) which lacks the deep posterior larval spiracular pit characteristic of most Sarcophagidae. The spiracles are fully exposed and surrounded by an oval peritreme marking the edge of the rudimentary pit of the third instar larva. Flies were usually found as either mature larvae or puparia in the host egg cases, having fed on the developing spiders eggs.

In 1983, a single puparium with a deep spiracular pit was found in an egg case. The female fly which emerged from it appeared to be identical in appearance to females which emerged from "pitless" puparia, but it was not possible to positively identify it. Collecting efforts were increased in 1984 and "pitted" puparia were recovered from two spider egg cases, from which two male and two female flies emerged. Examination of the terminalia of the males showed slight differences from those of specimens redescribed as *P. reposita* by Cantrell (1981). Moreover, they matched perfectly the original illustrations of the male terminalia of *P. reposita* made by Lopes (1959).

Cantrell (1981) assumed that the slight discrepancies between his illustrations and those of Lopes (1959) were due to difficulties in drawing the complex male terminalia. It is now apparent that the species redescribed by Cantrell (1981) was a new species, and that the true *P. reposita* was the species with a "pitted" puparium collected in small numbers in 1983 and 1984. Collecting in 1985 again produced low numbers of *P. reposita*, but showed that the new species (described below as *P. cyrtophorae*) is more commonly collected in the Brisbane area.

Lopes (1985) described a third species of Sarcophagidae known to be associated with spider eggs in Australia, naming it as the type species of a new genus, *Baranovisca.* The species is *B. arachnivora* Lopes, which was reared from an egg case of *Dicrostichus magnificus* Rainbow (Araniedae) in Sydney, New South Wales. He also transferred *P. reposita* (plus three non-Australian species) to *Baranovisca.* The defining characters of *Baranovisca* rely to a large extent on details of the male and female terminalia. The new species described below could also be included in *Baranovisca,* but I refrained from doing so, describing it instead in *Parasarcophaga.* The Australian sarcophagid fauna contains a number of small genera (largely erected by Lopes) differentiated by small differences in external morphology and terminalia from the two large genera, *Parasarcophaga* and *Tricholioproctia* Baranov. A thorough generic revision of the Australian Sarcophaginae is long overdue and until this is done (and *Baranovisca* retained or not), I prefer to adopt a conservative position for the species described below. Brown and Shipp (1978) also discussed the generic composition of the Australian Sarcophaginae following studies of wing morphometrics, and advocated the use of fewer, larger, genera for this group.

Having examined specimens of *B. arachnivora, B. reposita* and *P. cyrtophorae* it was possible to annotate distinguishing characteristics for each species based on the male and female terminalia. All three species are otherwise almost identical. Information on the relative abundance of *B. reposita* and *P. cyrtophorae* in Brisbane, also of their biology and that of their host (*C. moluccensis*) is presented below.

Abbreviations for specimen depositories are: AM, Australian Museum, Sydney; ANIC, Australian National Insect Collection, Canberra; QDPI, Queensland Department of Primary Industries, Brisbane; QM, Queensland Museum, Brisbane. Measurements of body length and ratio (V/HW) of width of vertex at level of posterior ocelli to maximum head width across eyes, both viewed dorsally, are expressed as means with ranges given in brackets. Number of specimens measured is shown last.

Parasarcophaga cyrtophorae sp. n.
(Figs 1-5, 14-16, 20)

Types.—*Holotype* ♂ Brisbane, QUEENSLAND, 28.ii.1984, B. K. Cantrell, ex egg case of *Cyrtophora moluccensis* (Doleschall), in QM. *Paratypes*, all same data as holotype except as indicated; 1 ♀ (QM); 1 ♂, 1 ♀, 4.iii.1984 (AM); 1 ♂, 1 ♀, 22.ii.1985 (AM); 2 ♂♂, 11+13, iii.1985 (ANIC); 2 ♀♀, 12.iii.1985 (ANIC); 1 ♂, 21.iii.1981, R. Raven (QDPI); 1 ♀, 22.iii.1981, R. Raven (QDPI); 1 ♂, 21.vi.1981 (QDPI); 1 ♀, 26.vii.1981 (QDPI); 1 ♂, 1 ♀, Feb. 1982 (QDPI); 1 ♂, 1 ♀, Mar. 1982 (QDPI); 1 ♂, 1 ♀, Aug. 1982 (QDPI); 1 ♂, 1 ♀, 7.iii.1983 (QDPI); 2 ♂♂, 2 ♀♀ (QDPI); 1 ♂, 1 ♀, 10.iii.1985 (QDPI); 1 ♂, 1 ♀, 16-17.iii.1985 (QDPI).

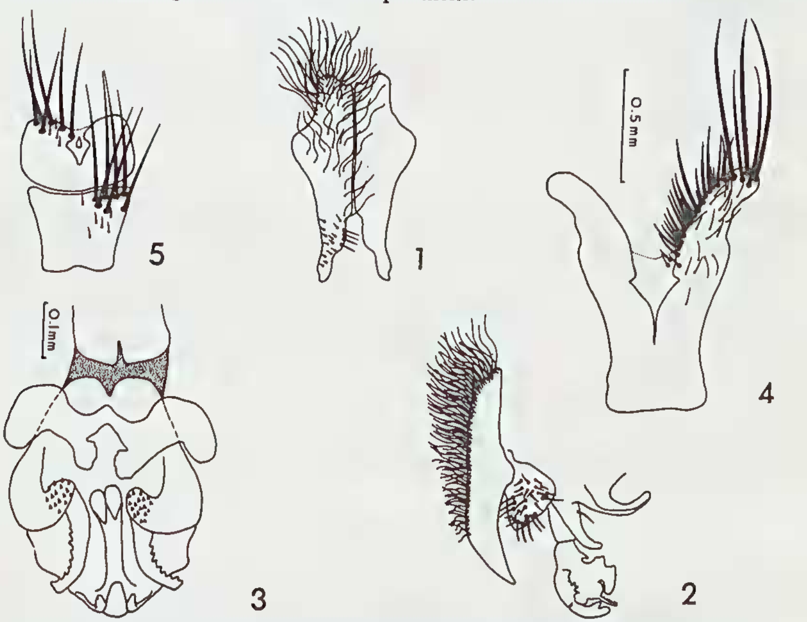
Non-type specimens examined.—Many specimens of both sexes, all Brisbane, Queensland, various dates between 1981-1985, from same host as holotype (QDPI), plus specimens listed by Cantrell (1981) as *Parasarcophaga reposita* Lopes (misidentification).

Description

For a full description of this species, including the immature stages, see pp. 29-33 of Cantrell (1981) under the heading *Parasarcophaga reposita* Lopes (misidentification) and Figs 1-5, 14-16, 20 below. Methods of differentiating this species from *B. arachnivora* and *B. reposita* are given below.

Measurements

Body length (mm): ♂ 9.7 (6.8-12.6); ♀ 9.8 (6.8-11.4). V/HW: ♂ 0.20 (0.19-0.22); ♀ 0.26 (0.24-0.28). (25 ♂♂, 25 ♀♀). Note that these values differ from those given by Cantrell (1981), being based on different specimens.



Figs 1-5. *Parasarcophaga cyrtophorae* sp.n. (1-4) male: (1) cerci, posterior view; (2) cerci, surstyli and aedeagus, lateral view; (3) tip of aedeagus, ventral view; (4) abdominal sternite 5, ventral view; (5) female abdominal sternites 6 and 7, ventral view. All to same scale except Fig. 3.

Etymology

The specific name alludes to the association between this fly and its only known host, *Cyrtophora moluccensis.*

Baranovisca arachnivora Lopes
(Figs 6, 8, 10, 12)

Baranovisca arachnivora Lopes, 1985: 51. Holotype ♂ (KS6986) in AM; type locality Hornsby Heights, New South Wales.

Specimens examined.–Holotype; paratype ♀ (AM), no locality label but associated with holotype by label on holotype "Sarcophagidae male, female, parasitic in egg sac *Dicrostichus magnificus*". The egg case (AM) from which these specimens emerged was also examined; it contains an additional male and female, both improperly emerged and deformed, plus empty puparia.

Notes

This species can only reliably be distinguished from *B. reposita* and *P. cyrtophorae* on terminalic characters (Figs 6, 8, 10, 12). The immature stages are unknown, but the puparium has a deep posterior spiracular pit. The adult measurements given by Lopes are accurate [Body length (mm): ♂, ♀, 9.0. V/HW: ♂ 0.17; ♀ 0.25.]

Baranovisca reposita (Lopes)
(Figs 7, 9, 11, 13, 17-19)

Parasarcophaga reposita Lopes, 1959: 65. Holotype ♂ in ANIC; type locality Sydney, New South Wales.
Baranovisca reposita: Lopes, 1985: 51.

Specimens examined.–Holotype; other specimens all Brisbane, QUEENSLAND, B. K. Cantrell, ex egg case *Cyrtophora moluccensis* except as indicated; all in QDPI; 1 ♀, 14.ii.1983, R. Haddrell; 2 ♂♂, 15.ii.1984; 1 ♀, 19.ii.1984; 1 ♀, 21.ii.1984; 5 ♀♀, 26.ii.1985; 1 ♀, 3.iii.1985; 1 ♀, 5.iii.1985; 1 ♂, 6.iii.1985; 1 ♂, 8.iii.1985.

Notes

This species is indistinguishable from *B. arachnivora* and *P. cyrtophorae* except by examination of the terminalia. Whole larvae were not available, but first and second instar exuviae recovered from a host egg case allowed examination of the cephalopharyngeal skeleton, while that of the third instar was recovered from an empty puparium. These are shown in Figs 17-19 and are clearly distinguishable from the corresponding photographs for *P. cyrtophorae.* In particular, note the lack of blunt cuticular spines on segment 2 of the first instar larva and the absence of the ventral spine on the mouthhooks of the third instar larva as seen in *P. cyrtophorae.* Puparia of the two species are also distinct as mentioned in the introduction.

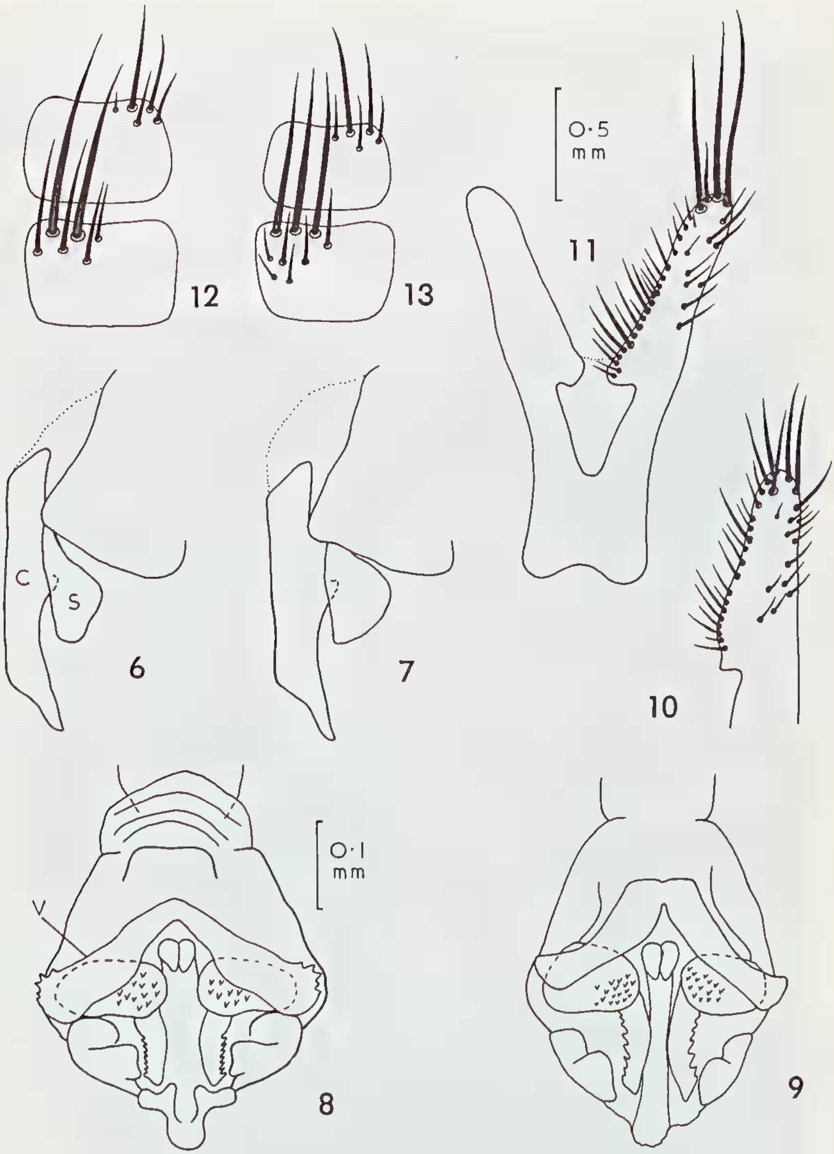
Measurements

Body length (mm): ♂ 9.6 (9.0-10.1); ♀ 8.6 (8.2-8.9). V/HW: ♂ 0.21 (0.20-0.22); ♀ 0.26 (0.25-0.27). (4 ♂♂, 10 ♀♀).

Species diagnosis

Adults of *P. cyrtophorae* may be distinguished from *B. arachnivora* and *B. reposita* as follows:

1. In the male by differences in the shape of the apical profile of the cerci (Figs 2, 6, 7) and ventralia of the aedeagus (Figs 3, 8, 9), also by the presence of more numerous and longer terminal setae on the lobes of abdominal sternite 5 (St5) (Figs 4, 10, 11).



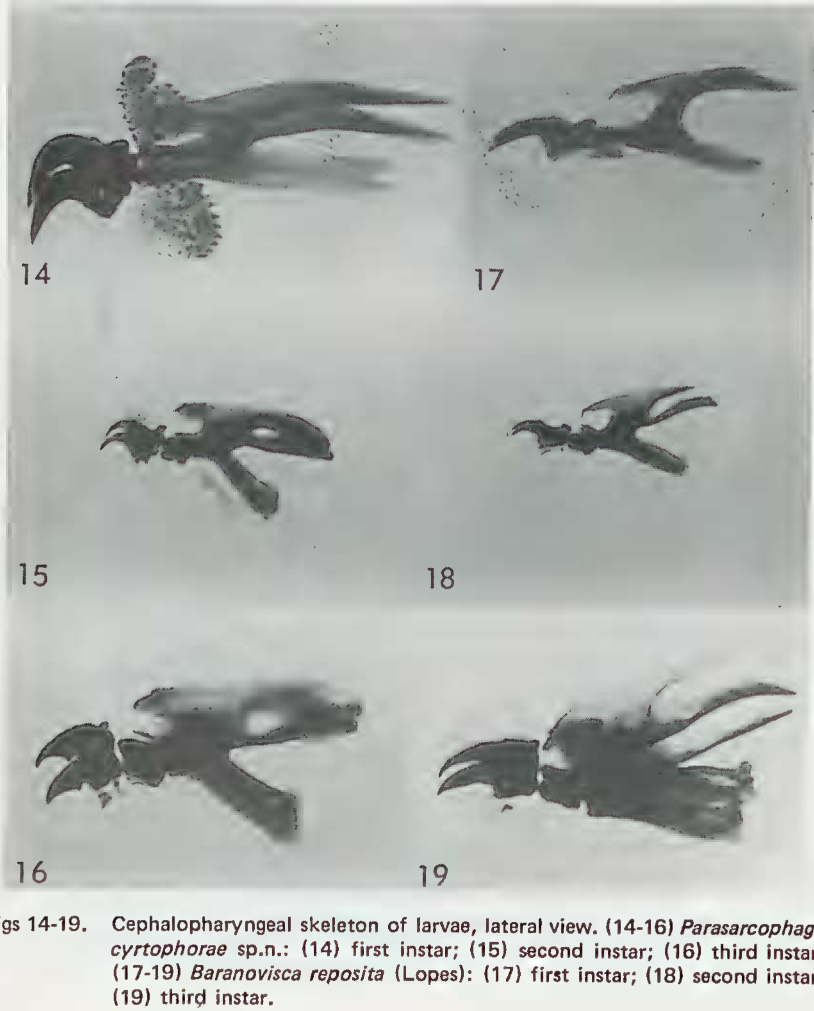
Figs 6-13. *Baranovisca arachnivora* (Lopes), left in each pair, and *B. reposita* Lopes, right in each pair. (6-11) male: (6, 7) cerci (c) and surstyli (s), lateral view; (8, 9) tip of aedeagus showing ventralia (v), ventral view; (10, 11) lobe of abdominal sternite 5, ventral view. (12, 13) female abdominal sternites 6 and 7, ventral view. All to same scale except Figs 8, 9.

2. In the female by the presence of a median decolourized area on the hind margin of abdominal sternite 7 (St7) (entire in *Baranovisca* spp.) and by the more numerous setae along this margin and that of St6. (Figs 5, 12, 13).

Adults of *B. arachnivora* and *B. reposita* are more difficult to separate:

1. In the male the cerci appear to be identical, but the shape of the surstyli in lateral view (Figs 6, 7) and the ventralia (Figs 8, 9) differ. Note also differences in the length of the terminal setae on the lobes of St5 (Figs 10, 11).
2. In the female, there are fewer setae on the hind margin of St6 in *B. arachnivora* than in *B. reposita* (Figs 12, 13).

Larvae of *B. arachnivora* are unknown. but those of *B. reposita* and *P. cvrtophorae* mav be separated by differences in the shape of the cephalopharyngeal skeleton (Figs 14-16, 17-19).



Figs 14-19. Cephalopharyngeal skeleton of larvae, lateral view. (14-16) *Parasarcophaga cyrtophorae* sp.n.: (14) first instar; (15) second instar; (16) third instar. (17-19) *Baranovisca reposita* (Lopes): (17) first instar; (18) second instar; (19) third instar.

Biology

During 1984 and 1985, egg cases of *Cyrtophora moluccensis* were examined for the presence of sarcophagids; any larvae or puparia recovered were reared to adults, when some were pinned and the others released after being sexed. Records were kept which trace the history of each egg case collected and the results are given in Tables 1-3. Spiders were observed at four suburban sites in Brisbane at Indooroopilly, Mitchelton, Rainworth and Yeerongpilly. Spiders were undisturbed until production of egg cases was generally well advanced, so that most spiders were guarding two or more egg cases when these were removed from the webs leaving the spider unharmed and the web damaged as little as possible. Many spiders produced further egg cases but these were not sampled.

In determining percentage predation, an egg case was considered to be attacked even if it contained only a single fly larva. In such cases, and those containing only a few larvae, not all the spider eggs were consumed so that some spiders successfully hatched.

The method of entry by the fly larvae into the spider egg cases is unknown. The cases are constructed in two halves held tightly together by an outer layer of webbing, and entry is probably made at some point along the join. Female flies were seen flying into webs and attempting to land on the string of egg cases, presumably to oviposit. Once the spider noticed the fly, she attempted to protect the egg cases by moving rapidly over them to prevent the fly from landing. In the few encounters observed the fly eventually left the web. Lubin (1974) gave greater details of observations on interactions between *P. cyrtophorae* (listed as an unidentified species of Sarcophagidae) and *C. moluccensis* in Papua New Guinea.

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Fig. 20. Scanning electron micrograph of posterior portion of puparium, *Parasarcophaga cyrtophorae* sp.n. Specimen platinum coated.

C. moluccensis is the only known host of the two species of sarcophagid recovered during the survey (*B. reposita* and *P. cyrtophorae*). The spider appears to be univoltine with mature females beginning to build obvious webs in early summer (November-December) and producing eggs mainly in January-March or April. It is not known whether the flies are also univoltine or if they have alternative hosts or breeding dites during the long period when eggs of *C. moluccensis* are unavailable.

Discussion

The three species of Sarcophagidae considered in this paper provide a good example of the difficulties encountered in the taxonomic study of Australian Sarcophaginae. Adult external morphology in this subfamily is generally very homogeneous, making it difficult to produce workable keys. The present generic concepts need to be revised using modern taxonomic methods [such as those employed by Brown and Shipp (1978)], and until this has been done there is little justification for the erection of further genera (such as *Baranovisca*). When a generic revision of our Sarcophaginae is eventually undertaken, the author responsible for it will be in a better position to take appropriate action on the several small genera.

Regardless of their generic identity, the three species under discussion are interesting because of their association with spiders, an unusual trait for sarcophagids which normally utilize carrion and similar decomposing organic matter as a larval medium. These are the only species of Sarcophaginae in Australia known to have such a habit but the species of *Baranovisca* are as yet poorly known, particularly in the immature stages (the immature stages of the non-Australian species of *Baranovisca* are unknown). Cantrell (1981) suggested that the broad blunt spines on segment 2 of the first instar larva of *P. cyrtophorae* and certain other features of later instar larvae such as reduced spination and absence of a deep posterior spiracular pit may be adaptations to its predatory life style. However, from what is known of the immature stages, *Baranovisca* spp. appear similar to typical sarcophagids. Thus the significance of the modifications in *P. cyrtophorae* remains uncertain, although its success in the study area may indicate that it is better suited to predation than, at least, *B. reposita.*

Table 3 shows the variability in rate of predation of *C. moluccensis* by *P. cyrtophorae* at different sites. The cause of such great variation was not investigated in this study. The table also illustrates relative abundances of *B. reposita* and *P. cyrtophorae* in the study area. Lubin (1974, Table 4) listed percentage parasitization of *C. moluccensis* by *P. cyrtophorae* in Papua New Guinea at rates ranging from 4.35% to 22.2%. The study area is the known northern limit of *B. reposita* and the known southern limit of *P. cyrtophorae.* The known southern limit of *C. moluccensis* is also southeast Queensland. It would be interesting to study predation of egg cases of related

TABLE 1
Summary of observations (pooled from all sites) on egg production and predation in *Cyrtophora moluccensis*, Brisbane, 1984 and 1985.

Year	Total no. spiders	Total no. egg cases	Mean per spider	Range	No. of affected egg cases	% predation
1984	57	166	2.91	1-6	27	16.2
1985	50	120	2.4	1-5	43	35.8

TABLE 2
Details (pooled from all sites) of predation of *Cyrtophora moluccensis* by *Parasarcophaga cyrtophorae* and *Baranovisca reposita*, Brisbane, 1984 and 1985.

Year	Species	No. of egg cases affected	% Predation	No. Predators	Mean per egg case	Range*	Sex ratio of emerged adults** ♂	♀
1984	*P. cyrtophorae*	25	15.0	83	3.32	1-6	28	37
1984	*B. reposita*	2	1.2	8	4	3-5	2	2
1985	*P. cyrtophorae*	39	32.5	128	3.28	1-7	32	44
1985	*B. reposita*	4	3.3	13	3.25	1-7	3	8

* 10 puparia of *P. cyrtophorae* were recovered from a single egg case in 1982.
** The discrepancy between the total of males plus females and the number of predators is because some flies died as immatures and others had already emerged as adults and escaped before sampling occured.

TABLE 3
Percentage predation of *Cyrtophora moluccensis* by *Parasarcophaga cyrtophorae* and *Baranovisca reposita* at four sites in Brisbane, 1984 and 1985.

Year	Species	% predation* at each site: Indooroopilly	Mitchelton	Rainworth	Yeerongpilly
1984	*P. cyrtophorae*	44.4 (7-18)	11.8 (43-118)	n.s.	10.0 (7-30)
1984	*B. reposita*	0.0 (7-18)	1.2 (43-118)	n.s.	0.0 (7-30)
1985	*P. cyrtophorae*	n.s.	35.0 (39-92)	57.1 (2-7)	32.5 (9-21)
1985	*B. reposita*	n.s.	3.0 (39-92)	0.0 (2-7)	4.0 (9-21)

n.s. = not surveyed.
* Figures in parentheses indicate the total number of spiders webs examined followed by the number of egg cases sampled for that site.

spiders in New South Wales to determine the nature of the predator complex, and if possible, find the host(s) of *B. reposita.*

B. arachnivora and *B. reposita* appear to be very closely related species and it would be useful to have larger series of each for study so that their relationship can be better determined. The type specimens of *B. arachnivora* emerged from an egg case of *D. magnificus.* Unlike those of *C. moluccensis* described above, egg cases made by this spider are larger, spindle shaped and have no apparent weaknesses in their outer covering, and it is unclear how the fly larvae gained entry. The single egg case examined was largely filled with loosely woven silk and the egg mass appeared to be smaller than in normal egg cases of *C. moluccensis,* perhaps indicating that *D. magnificus* is not as suitable a host. Studies of further egg cases of *D. magnificus* would be helpful in order to determine whether predation by *B. arachnivora* is a regular event.

Elgar *et al.* (1983) studied the biology of *C. hirta* (L. Koch) in Brisbane but apparently found no evidence of egg predation by sarcophagids. A single egg case of *C. hirta* examined in the present study was also undamaged. Elgar *et al.* (1983) found *Stathmopoda arachnophthora* (Turner) (Lepidoptera: Stathmopodidae) parasitizing eggs of *C. hirta* and commented that they knew of no other reports of lepidopteran parasitism in this spider genus. This moth was not noted in the present study but larvae of *Pyroderces* sp. (Lepidoptera: Cosmopterygidae) were regularly recovered from egg cases from which *P. cyrtophorae* had emerged. They appeared to be scavengers rather than parasites but perhaps deserve further investigation.

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References

Brown, K. R. and Shipp, E., 1978. Wing morphometric analysis of Australian Sarcophaginae (Diptera: Sarcophagidae). *Syst. Ent.* 3: 179-188.

Cantrell, B. K., 1981. Redescription of *Parasarcophaga reposita* Lopes (Diptera: Sarcophagidae). *Aust. ent. Mag.* 8: 29-35.

Elgar, M. A., Pope, B. and Williamson, I., 1983. Observations on the spatial distribution and natural history of *Cyrtophora hirta* (L. Koch) (Araneae: Araneidae) in Queensland, Australia. *Bull. Br. arachnol. Soc.* 6: 83-87.

Lopes, H. de Souza, 1959. A revision of Australian Sarcophagidae (Diptera). *Studia Ent.* 2: 53-67.

Lopes, H. de Souza, 1985. A new genus of Sarcophagidae (Diptera) based on an Australian species living in spider egg cases. *Aust. ent. Mag.* 12: 51-53.

Lubin, Y. D., 1974. Adaptive advantages and the evolution of colony formation in *Cyrtophora* (Araneae: Araneidae). *Zool. J. Linn. Soc.* 54: 321-339.